STATUS REPORT

TO

THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

TITLE OF RESEARCH

SURFACE IONIZATION PHENOMENA

NsG-67-60

Submitted By

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1. Period Covered: June 30, 1964 - February 28, 1965

2. Resume of Research Progress

Preliminary experiments with the surface ionization apparatus are now in progress. Potassium and sodium positive ions have been observed arising from impurities in the tungsten filament. The potassium isotopes are readily resolved by the mass spectrometer indicating that its operation is satisfactory. At background gas pressures of 1×10^{-7} torr, negative ions are observed in the absence of the molecular beam. These ions are not, in general, formed by surface ionization, but originate from electron collisions in the background gas. Ions so observed are H^-, C^-, and O^- plus small traces of other ions. The large background O^- (about 10^{-14} amp) has prevented measurements of the surface ionization of O_2 so far.

Surface ionization has been observed, however, for molecular beams of Cl_2, Br_2, CCl_4, and CF_2Cl_2. The negative ion currents increase at low temperatures, but pass through a maximum at about 2,000°K and fall off at higher temperatures. Either equilibrium is not established at the higher temperatures (too short a residence time) or the work function of the tungsten is lowered at high temperatures due to diffusion of potassium and sodium to the surface. Experiments are in progress to resolve this question.

The F^-/Cl^- ratio was determined as a function of temperature for the surface ionization of CF_2Cl_2. From these results, the difference in electron affinities, $E_{Cl} - E_F$ was found to be 0.12 ev in fair agreement with the currently accepted value. This indicates that the molecule CF_2Cl_2 is completely dissociated on the surface.

3. Future Direction of Research

It is planned to incorporate a vibrating reed molecular beam chopper into the apparatus and use a phase sensitive detecting system in order to eliminate the problem of background ions. It is also possible with phase sensitive detection to learn something about residence times on the surface.

It will be necessary to use a better grade of tungsten ribbon in future experiments. So far we have been unsuccessful in locating a supplier of ribbon of the necessary purity. It is possible, however, to deposit pure tungsten from tungsten carbonyl onto a tungsten ribbon. We plan to try this technique. We also plan to try tantalum for the negative ion experiments. It has the advantage of a somewhat lower work function than tungsten.

4. Publications and Technical Papers

1) "The Mass Spectrometer as a Research Instrument," E. E. Muschlitz, Jr. Invited paper presented at the American Chemical Society Symposium on "Recent Advances in Physical Chemistry," New York, September, 1960. To be published in J. Chem. Ed.

2) "Mass Spectra of Positive and Negative Ions in Nitrous and Nitric Oxides," Thesis by C. S. Harden. Submitted as a NASA Technical Report.

5. Period of Grant: July 1, 1963 - June 30, 1966

6. Personnel

(1) E. E. Muschlitz, Jr.	Professor of Chemistry Principal Investigator
(2) C. S. Harden	Graduate Assistant (NASA supported)